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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of the	)	
	)	
Revision of Part 15 of the	)	ET Docket No. 98-153
Commission's Rules Regarding	)	
Ultra-Wideband Transmission Systems	)	

REPLY COMMENTS OF XM RADIO INC.

XM Radio Inc. ("XM Radio") hereby replies to comments submitted in response to the Commission's Notice of Proposed Rulemaking ("*NPRM*") regarding rules for new types of products incorporating ultra-wideband ("UWB") technology.[1] XM Radio agrees with other commenters that UWB is fundamentally different from the technology used in existing services and requires the Commission to gain a more complete and scientific understanding of the technology before allocating spectrum for any service utilizing this technology. XM Radio also agrees with other commenters that, if and when it adopts rules for UWB operations, the Commission should establish a phased approach to the introduction of UWB, licensing devices on an application-by-application basis and only after a given UWB applicant has demonstrated through comprehensive testing that its devices will not interfere with any licensed services. In addition, XM Radio continues to believe that it should impose severe restrictions on emissions from applications using this technology below 3 GHz in order to protect DARS and other licensed services.

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[1] XM Radio's satellite Digital Audio Radio Service ("DARS") system was licensed by the Commission in 1997. American Mobile Radio Corporation, 13 FCC Rcd 8829 (Int'l Bur., 1997). As the Commission has repeatedly recognized, DARS promises enormous public interest benefits for the U.S. public, providing a high-quality, continuous, nationwide multichannel audio service. Report and Order, Memorandum Opinion and Order, Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band, 12 FCC Rcd 5754, para. 1 (1997).

Background

In response to the Commission's *NPRM*, comments were filed by more than a hundred parties. Numerous licensees and representatives of licensees opposed many of the proposals and findings contained in the *NPRM*. These opponents point out generally that the Commission's proposals are premature, that the Commission should take no action in this proceeding until comprehensive testing is completed and analyzed, and that if the Commission adopts rules for UWB operations in this proceeding they should be much more restrictive than proposed in the *NPRM*.[2]

Numerous developers of various UWB applications and other parties with an economic interest in this technology also filed comments, generally arguing that the Commission should take the steps necessary to promote UWB development, including adopting restrictions less stringent than proposed in the *NPRM*.[3] One major UWB developer, MSSI, fully recognizes the need to protect licensed services, however, and states that the Commission should adopt restrictions more stringent than proposed.[4]

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2 *See, e.g.*, Comments of AT&T Wireless Services, Inc. (September 12, 2000) ("AT&T Wireless Comments"); Comments of the Boeing Company (September 12, 2000) ("Boeing Comments"); Comments of Mobile Communications Holdings, Inc. (September 12, 2000) ("MCHI Comments"); Comments of National Association of Broadcasters (September 12, 2000) ("NAB Comments"); Comments of Sirius Satellite Radio Inc., (September 12, 2000) ("Sirius Comments"); Comments of the U.S. GPS Industry (September 12, 2000) ("GPS Council Comments").

3 *See, e.g.*, Comments of Fantasma Networks, Inc. (September 12, 2000) ("Fantasma Comments"); Comments of Time Domain Corporation (September 12, 2000) ("Time Domain Comments"); Comments of XtremeSpectrum, Inc. (September 12, 2000) ("XtremeSpectrum Comments").

4 See Comments of Multispectural Solutions, Inc. (September 12, 2000) ("MSSI Comments"). Some potential users of UWB technology filed numerous letters and other brief comments describing various social, health, and other public interest benefits that might result from the proliferation of UWB technology. Comments of City Burbank (September 6, 2000); Comments of Florida Adult Day Care Association (September 7,

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Discussion

I. Any Commission Action on UWB Technology Would Be Premature, Given the Novel and Fundamentally Unique Nature of UWB Pulsed Transmissions

Consistent with XM Radio's own comments, numerous commenters argue that the Commission's proposals regarding UWB technology are premature. *See, e.g.*, NAB Comments at 2-3; Sirius Comments at 23-26. XM Radio agrees that these proposals reflect the Commission's failure to recognize and account for the basic differences between UWB technology and all other licensed services and applications. While the Commission has historically allocated spectrum and assigned licenses by segmenting spectrum in the frequency domain, UWB technology instead utilizes short-duration, narrow-width pulses that cover extremely wide swaths of frequencies. Before the Commission adopts rules permitting UWB devices to share licensed spectrum or takes any other meaningful steps in this proceeding, it must confront and determine the appropriate approach for dealing with the orthogonality of UWB technology. In order to do so, the Commission should first direct a basic scientific study of the interaction between pulse-based devices and frequency domain devices. As the U.S. GPS Council has pointed out, effective regulation of UWB technology will be a paradigm shift in the Commission's spectrum management processes, and any such move certainly should have a valid scientific grounding. GPS Council Comments at 3.

II. If the Commission Adopts Rules for UWB Operations, It Should License UWB Equipment on an Application-by-Application Basis, Rather Than Permit These Devices to Operate Under Part 15

The Commission proposes in the *NPRM* that UWB technology be permitted to operate above 2 GHz on an unlicensed basis under existing Part 15 field strength limits. XM Radio

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2000). This last category of commenters completely ignores the potential for interference to existing services from an uncontrolled and ubiquitous launch of UWB applications.

agrees with those commenters who view this as a fundamentally flawed approach. *See, e.g.*, Boeing Comments at 13-15; Sirius Comments at 20-22. Given the nature of UWB technology, field strength limits, including even those more restrictive than those currently in Part 15, are unlikely to be sufficient to prevent interference to DARS and other licensed services. This is because of the potential of UWB transmissions to be seen by affected receivers as pulses rather than noise, depending on such variables as an emission's pulse energy, pulse shape, pulse repetition frequency ("PRF"), and pulse width. If a transmission places very high energy pulses within repeater and satellite receiver basebands, it will likely cause interference to DARS reception even if such emission complies with XM Radio's proposed field strength limit of 18 uV/m at 3 meters over 1 MHz.[5] In addition, the Part 15 remedy for interference – cessation of operation of interfering devices – is inadequate. Victims of interference from unlicensed devices in most cases cannot identify the interfering transmissions, and, even when they can, it unrealistic to believe that the Commission will be able to track down the offending devices and enforce such a prohibition.

Rather than issue a sweeping approval of pulse-based UWB technology above 2 GHz, XM Radio agrees with other commenters that if the Commission permits UWB to operate, it should license UWB equipment on an application-by-application basis, or by classes of applications with similar interference characteristics. *See* Boeing Comments at 13-15; Sirius Comments at 20-22. In such filings, UWB applicants should be required to demonstrate through comprehensive testing that their UWB operations will not pose an unreasonable threat of interference to any licensed services. Unlike the UWB tests that have been conducted and are

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[5] XM Radio certainly disagrees with Fantasma Networks that UWB emissions will be seen by affected receivers as background noise only. Fantasma Comments at 1. XM Radio agrees with Zircon, moreover, that it would be difficult to develop a technical standard

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ongoing, such testing must systematically test for effects on *every* potentially affected licensed communications service,[6] consider the likely physical implementations of that use, and account for the likely cumulative impact of multiple UWB emitters on licensed services resulting from those implementations. The Commission's application process should give all potentially affected licensed service providers an opportunity to review and comment on this technical showing.

Such a phased licensing approach is consistent with the Commission's traditional service-by-service licensing framework, will facilitate a more realistic timetable for the introduction of UWB technology (compared to the Commission's currently precipitous path), and is appropriate in light of the widespread interference risk. There will likely be a wide variety of UWB applications, and for the most part these applications remain undeveloped and undefined at this time. The Commission, XM Radio, and other licensed service operators do not and cannot understand the characteristics, including their potential for interference, of all of the potential applications of UWB technology until those applications have been developed and defined.

III. If the Commission Does Establish Rules for UWB Operations in the Near Term, It Should Greatly Restrict UWB Emissions Below 3 GHz

The majority of UWB proponents argue that UWB technology should be permitted to operate above 2 GHz with little restriction. For example, while it concedes the need to protect GPS in the 1.6 GHz band, Fantasma supports the Commission's tentative conclusion that signal

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for UWB devices that would cause their emissions to approximate background noise, rather than pulsed energy. Zircon Comments at 3.

6 None of the test programs currently underway, including those at NTIA, Stanford University, and the University of Texas, are testing the effects of UWB emissions on non-GPS commercial services.

propagation losses and the directionality of antennas in services above 2 GHz render the radio services above that threshold immune from interference. Fantasma Comments at 3-4. UWB proponents generally argue that the Commission's current field strength limits contained in Part 15 are sufficient to protect licensed services from interference from UWB emissions above 2 GHz. Time Domain Comments at 30; XtremeSpectrum Comments at 9. Time Domain and others contend that these limits are also sufficient to protect existing services below 2 GHz, and that the Commission's proposal that UWB emissions below that threshold be suppressed an additional –12 dB is unnecessary. *See* Time Domain Comments at 30. According to Time Domain, the Part 15 limits have been stringent enough to protect licensed services from unintentional emissions from the millions of personal computers and other digital devices that have pervaded the modern RF environment, and they will also be sufficient in the UWB context.[7] *Id.*

XM Radio strongly disagrees with these commenters. If the Commission does adopt rules for UWB in the near term, XM Radio agrees with Sirius Radio and others that an appropriate threshold for less stringent limits on "free space" UWB emissions (UWB applications other than GPRs and other similar imaging devices) is above 3 GHz.[8] Certainly, UWB proponents have not presented any evidence that UWB devices can operate below 3 GHz without causing interference to existing services.[9] For instance, while TDC asserts that UWB

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[7] XtremeSpectrum, for example, states that its UWB equipment will meet the current 500 uV/m at 3 meters limit applicable to emissions above 960 MHz, and that such compliance should be enough to permit the operation of its technology. XtremeSpectrum Comments at 5-6. (XtremeSpectrum is one of the only UWB proponents that has actually provided some specific technical data about its system.)

[8] XM Radio here reiterates its view that GPRs, wall-penetrating radars, and other imaging devices are unlikely to pose a significant threat of interference to DARS reception.

[9] As shown by the comments in this proceeding, there are numerous important services between 2 and 3 GHz that would likely be affected by an unchecked proliferation of

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systems operating with nominal center frequencies above 2 GHz would cause no interference to DARS and other licensed services, it provides no quantitative support for this assertion; clearly, its stated "firm belief" that its operations will not cause interference is not enough.[10] As a general matter, UWB proponents appear to lack an understanding of DARS and the specific effects of UWB transmission on DARS reception.

Numerous comments from licensed operators show that the Commission and various UWB proponents are mistaken when they claim that greater propagation losses and a lack of omnidirectional antennas above 2 GHz justify UWB spectrum sharing above that threshold. In particular, comments from Sirius and Cisco Systems indicate that there is little difference in propagation losses between 2.0 GHz and the 2.3-2.5 GHz band. Comments of Cisco Systems, Inc., at 5 (September 12, 2000) ("Cisco Comments"); Sirius Comments at 13-14. In addition, as discussed in XM Radio's comments and comments from Sirius, MCHI, and Cisco, DARS receivers, Big LEO mobile terminals, and MDS systems all use omnidirectional antennas above 2.0 GHz. Cisco Comments at 5; MCHI Comments at 1-2; Sirius Comments at 14.

Nor have UWB proponents put forth evidence in the record that UWB applications (other than GPR and other imaging devices) cannot operate exclusively above 3 GHz. Rather, UWB communications devices and other applications should be able to operate and function in a variety of regions of the spectrum, without suffering added costs or unnecessary complexity.

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UWB technology. These services include Aeronautical Radio-Navigation, Amateur Radio & Satellite, Big LEO MSS, DARS, MDS/ITFS, and WCS.

10 In its comments, Time Domain discusses its planned use of UWB location and tracking devices in combination with UWB communications devices. Time Domain Comments at 14. While in that context UWB communications transmissions would be unlikely to cause interference to DARS if held to an extremely low power, the operation of such systems would likely permit the development of other systems with a 2 GHz center frequency that would be much more likely to interfere with DARS.

MSSI and Fantasma, which are developers of UWB technology, both indicate that spectrum below 2 GHz is not needed for UWB communications services. Fantasma Comments at 3; MSSI Comments at 12. MSSI states in its comments that concerns expressed by other UWB proponents regarding pulse shape distortion and other performances losses stemming from operations above 3 GHz are overblown, and it argues that even filtered UWB systems should be permitted to operate only above 3.1 GHz. In fact, MSSI argues that the Commission should explore using unrestricted spectrum in the 5.46 GHz to 7.25 GHz band for UWB communications and radar applications. MSSI Comments at 13.

As explained in its comments, XM Radio also believes that the existing Part 15 field strength limits will not be nearly stringent enough to protect XM Radio's DARS reception. As an initial matter, field strength limits themselves will be essentially worthless as a tool to protect DARS and other services where UWB transmissions appear to the affected receivers as pulsed energy. In those instances, it will be other variables – such as PRF, pulse width, and others – that determine whether the affected receiver will suffer interference.

Where the effect of a UWB emission is to raise the noise floor for reception of a licensed service, however, UWB field strength will be critical. XM Radio maintains its belief that a field strength limit of 18 uV/m at 3 meters over 1 MHz in the DARS band is necessary to protect DARS reception, particularly in the face of the cumulative interference effects that both the Commission and UWB proponents choose to ignore.[11] Counter to GE's claim, UWB emissions

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[11] On the issue of peak emissions, until there has been a complete characterization of UWB emissions, XM Radio cannot comment on the Commission's proposed definition of peak-to-average limits for emissions and their effects on DARS. XM Radio disagrees with Delphi that the overall magnitude of the absolute peak limit does not need to be relaxed as much as the Commission has proposed. Comments of Delphi Automotive Systems Corporation, at 8-9 (September 12, 2000). With respect to measurement of peak emissions, XM disagrees with the contention of some UWB proponents that because it will be difficult to measure peak power, there is little value in measuring such peak

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up to the current Part 15 limits would be well above XM Radio's noise floor. Comments of General Electric Company, at 1 (September 11, 2000). As explained in its comments, XM Radio's receivers will receive wideband (2 MHz) digital signals from its fixed-power satellite, and XM Radio's system operates at low signal-to-noise ratios. Any raising of the noise floor for DARS, thereby reducing its system's signal-to-noise ratio, will likely be extremely harmful to the development of DARS and should not be permitted by the Commission. In these respects, DARS is similar to GPS, and the recognition by the Commission and even UWB proponents regarding the sensitivity of GPS to interference from UWB emissions should extend to DARS also.[12]

Some UWB proponents argue that rather than precluding or restricting UWB emissions below 2 GHz, the Commission should identify those licensed service bands that need special protection from UWB emissions and require UWB devices to nullify or suppress their UWB signals in just those specific bands. Aether Comments at 7; XtremeSpectrum Comments at 5. Aether, for instance, indicates that it will be able to utilize "notching" techniques to nullify UWB pulses and noise within the GPS band. Aether Comments at 7. XM Radio is uncertain about the potential effectiveness of such techniques, and it continues to believe that limiting UWB emissions to the spectrum above 3 GHz is the best way to protect DARS and other vulnerable licensed services. At the same time, if UWB proponents can demonstrate through

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emissions. *See, e.g.*, Time Domain Comments at 34. If the PRF and other key variables of a given UWB emission are such that a DARS receiver sees that UWB energy as pulses within the DARS pass band, then absolute peak levels are critical to XM Radio and must be measured.

12 XtremeSpectrum suggests that the Commission could protect licensed services from interference by initially limiting the operation of UWB devices to indoor environments. XtremeSpectrum Comments at 11. XM Radio does not believe that such a restriction would provide sufficient protection to DARS reception.

comprehensive testing that such notching techniques can in fact effectively protect not only GPS but DARS and all other susceptible allocated and licensed services, XM Radio will be open to this regulatory approach.

Finally, XtremeSpectrum argues that technological neutrality requires that the Commission adopt rules that will permit UWB proponents to develop competitive communications systems and services. XtremeSpectrum Comments at 4-5. This claim misses the point. Technological neutrality does not mandate the adoption of rules that are insufficiently stringent to prevent interference to numerous licensed services, as would result if the Commission permitted UWB operations above 2 GHz at field strength levels by permitted by Part 15.

Conclusion

For all of the aforementioned reasons, the Commission should adopt the rules and policies described herein regarding the operation of ultra-wideband devices.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I, Sylvia A. Davis, a secretary to the law firm of ShawPittman, hereby certify that on this 27th day of October 2000, served a true copy of the foregoing **"REPLY COMMENTS OF XM RADIO INC."** by first class United States Mail, postage prepaid, upon the following:

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Document #: 1031611 v.1